Agency inspectors might be unfamiliar with the plant and might be unaware of safety concerns that plant personnel deal with daily.

Agency inspectors are more at risk from potential hazards than are plant personnel. Inspectors are rarely familiar with possible walking hazards, such as missing grate sections, protruding beams and valves, weakly supported ladders and guard rails, and exposed electrical lines. Plant personnel might take such conditions for granted and forget to point them out to visiting inspectors. Also, inspectors can become so preoccupied with conversations with plant personnel that even obvious hazards are not recognized. On occasion, plant personnel attempt to speed up an inspection so that they can get back to more pressing production-related duties. This inadvertently increases the risk of injury.

Inspectors, who often do their work in a different plant each day, do not have the opportunity to acclimate themselves to the heat stress caused by some systems. Also, an inspector might be sensitive to certain materials used in, or certain pollutants generated by, plant processes.

Because of the numerous potential hazards, each inspector must adhere to established safety policies and procedures. Also, inspectors must recognize unusual and extreme conditions under which additional or extreme safety precautions are warranted.

General Rules

To minimize the risk of potential hazards, each inspector should follow the general rules summarized below.

The inspection should be halted immediately if the inspector suffers one or more of the nonspecific symptoms of exposure.

The inspection should be halted immediately if the inspector suffers one or more of the nonspecific symptoms of exposure, which include headaches, nausea, drowsiness, chest pains, shortness of breath, light-headedness, and eye irritation. Although these symptoms might not be due specifically to exposure, the inspector should not assume this. These symptoms are the first indicators of exposure to a variety of pollutants, and such exposure can quickly be disabling. An inspector experiencing any of these symptoms, should immediately go to a well-ventilated area. The inspector should not approach the area of possible exposure again until adequate personal protection equipment has been secured.

The inspection should be conducted at a controlled pace to minimize accidents.

The inspection should be conducted at a controlled pace to minimize accidents while walking and climbing. The inspector must never shortcut safety procedures.

The inspection should be postponed if it cannot be conducted safely.

Occasionally, an inspection must be terminated because of safety risks. The most common risks include inclement weather, severely vibrating fans, apparently weak walkways or roofs leading to a control device, high concentrations of fugitive pollutants, and intermittent releases from process equipment. If the inspection cannot be accomplished safely, it should be postponed until the appropriate engineering controls and/or plant operational procedures are changed to permit a safe inspection. After terminating the inspection, the inspector should inform his or her

supervisor of the problem, and alternative inspection procedures should be established by follow-up negotiations with plant management. The inspection should be completed immediately after the necessary changes are made.

The health and safety of the inspector and plant personnel should never be risked, and the condition of plant equipment should not be compromised. Equipment-related factors often limit the effectiveness of an inspection. For example, many control systems do not have any test ports to facilitate measuring static pressures, temperatures, and O_2 concentrations. Often, when ports are available, they are in dangerous locations. The inspector should not attempt to use these ports and should not ask plant personnel to do so.

The health and safety of the inspector and of plant personnel should never be risked, and the condition of plant equipment should not be compromised.

All agency and plant safety requirements must be satisfied at all times. It is the responsibility of each inspector to know all of the applicable safety requirements for each plant and to know all agency safety requirements. Even if plant personnel are not using common safety equipment, such as hard hats and safety shoes, the inspector must always use this equipment. The inspector cannot let plant personnel dictate or influence what safety procedures are to be followed.

All agency and plant safety requirements must be satisfied at all times.

Basic Safety And Health Procedures For Inspecting Air Pollution Control Systems

Some of the hazards most frequently encountered when an inspector is evaluating an air pollution control system are summarized in this section. Specific procedures to minimize risk to the inspector, plant personnel, and plant equipment are discussed in more detail in the *Air Pollution Source Inspection Safety Self-Instructional Course.* (The student is encouraged to take this course before conducting any field inspections.)

Basic Safety Procedures

Personal protection equipment. Agency inspectors should have their own personal protection equipment and ensure that it is in good working order.

Use your own protective equipment.

Internal inspections. Under no circumstances should agency inspectors attempt to enter air pollution control devices or associated process equipment. All of the information necessary to make a complete and accurate assessment of performance can be obtained without entering a control device.

Never enter control devices or process equipment.

Unaccompanied inspections. The agency inspector should insist that at least one responsible plant representative accompany him or her at all times.

Always have plant personnel accompany you.

Warning codes and sirens. Before conducting an inspection, the inspector should learn the warning codes and sirens used at that plant. The inspector

Know plant warning codes and sirens and associated actions.

should move to a safe location as rapidly as possible after hearing a warning siren. Upon reaching a secure area, the inspector and plant representative should "check in" with the appropriate authorities so that no attempt is made to rescue them from an affected area.

Summon help to conduct rescues.

Personnel rescue. An agency inspector who sees that another individual has been hurt should summon help.

Interrupt or postpone inspections during inclement weather.

Inclement weather conditions. Except in the case of public health emergencies, field activities should be interrupted or postponed whenever severe weather conditions present a significant safety risk. As a general guideline, work should be delayed whenever the ambient temperature is less than -20 °F (wind-chill factor); the ambient temperature is greater than 100 °F; the wind speed is greater than 25 mph; or when there is snow, sleet, or freezing rain.

Walking And Climbing Hazards

Wear a hard hat and safety shoes.

Hard hats. An agency inspector should **always** wear a hard hat when inspecting a facility.

Safety shoes. Agency inspectors should wear water-tight safety shoes approved for the specific type of facility being inspected. In all cases, the shoes should be slip-resistant to minimize the risk of falls in wet and icy areas. Inspectors should ask plant personnel which type of shoes to wear: shoes with conductive soles (to prevent static accumulation); shoes with wooden soles; or shoes with metatarsal protection.

Wear gloves when climbing ladders and when handling hot equipment.

Gloves. Inspectors should wear gloves when the inspection will involve climbing ladders and/or handling hot instrument probes.

Try to avoid slippery areas, temporary walkways, and roofs.

Slippery areas. The inspector should avoid areas of the facility that have potentially slippery surfaces. Common slippery areas include concrete surfaces under hoppers, areas adjacent to wet scrubber pumps, and oily surfaces. Icy surfaces along catwalks and in depressions around roof-mounted collectors should also be avoided.

Temporary walkways. Inspectors should not use poorly constructed temporary walkways, such as planks and horizontal ladders. Specially constructed temporary walkways should be used only when both ends are firmly secured and when the construction materials can handle the weight.

Elevated walkways. Before walking on elevated catwalks around or leading to control systems, the inspector should confirm, to the extent possible, that the supports are intact and have not corroded or rotted.

Roofs. The inspector should avoid, to the extent possible, all roofs and other elevated, horizontal surfaces. Inspectors should follow plant personnel in these areas and should use defined walkways.

Climbing ladders (all types). When climbing any ladder, the inspector should grasp the foot rungs (not the side rails), even when the rungs are wet or muddy. Under no circumstances should an inspector attempt to climb a ladder that is covered with ice or snow. Both hands must always be free for climbing ladders; therefore, the inspector should not carry portable instruments, probes, and sample bags in his or her hands. To prevent injuries from falling objects, only one person should be on a ladder segment at a time (except in emergencies).

Grasp foot rungs, rather than side rails, when climbing ladders.

Portable ladders. The inspector should use portable ladders that are in good physical condition. The ladders should be inclined so as to minimize the chances of both slipping and toppling and must have secure footing on the bottom to prevent slipping. The ladder must extend at least 3 ft above the surface being reached. The ladder must also be a safe distance from high-voltage electrical lines and out of the path of low-elevation steam vents and pollutant vents.

Use ladders that are in good physical condition.

Fixed ladders. The inspector should use fixed ladders that are in good physical condition. The cage (if present) must have an opening of 18 to 24 in. at the top and should not be severely distorted, because this would prevent easy movement inside. There must be at least a 9-in. clearance between the ladder and the object to which it is secured. The rungs must be evenly spaced. A caged ladder should extend at least 3 ft above the platform or surface being reached. Entry to the top of the ladder should be blocked by a chain or passive restraint. Ladders must be a safe distance from high-voltage electrical lines.

Guard rails. The inspector should avoid leaning against a guard rail and should never use a guard rail for climbing.

Do not lean on guard rails or use them for climbing.

Protruding obstacles. When walking through a plant, inspectors must be alert for protruding obstacles, such as conduit supports, beams, valves, conveyors, and support wires. It is advisable to wait several minutes for the eyes to adjust whenever entering an inside area from the outdoors before proceeding with the inspection.

Avoid protruding obstacles and rotating equipment.

Rotating equipment. Ties and loose clothing should not be worn when conducting an inspection. Because it is often impossible to see high-speed components move, inspectors must be cautious when they are near rotating equipment. Equipment that operates intermittently (e.g., hoists) should never be touched.

Elevated platforms. Inspectors occasionally must perform inspections on elevated platforms. The inspector should evaluate the potential for exposure to toxic gases, steam, or other hazards that could possibly occur. Remember, egress is difficult under normal conditions from elevated work areas and extremely difficult under emergency evacuation conditions. Emergency conditions could include not only accidental chemical releases from the plant but also sudden storms or fog.

Stay at least 75 ft from cars on rail sidings.

Rail sidings. Agency inspectors should stay at least 75 ft from all stationary cars on rail sidings because these are sometimes coupled to remote-controlled engines run by an operator who does not have a complete view of the siding areas. Also, inspectors should not approach areas near car pullers because failure of the cable that pulls the cars can lead to serious injuries.

Do not stand on storage piles.

Material piles. Inspectors should not stand on coal piles, material stockpiles, or fixed-sludge lagoons.

Avoid severely vibrating fans and inform plant personnel immediately.

Severely vibrating fans. The inspection should be terminated immediately if a severely vibrating fan is encountered. Plant personnel should be notified immediately if significant vibration is suspected.

Eye Hazards

Do not wear contact lenses during an inspection.

Contact lenses. The inspector should not wear contact lenses during an inspection.

Always use safety glasses with side shields.

Safety glasses. Inspectors should use safety glasses with side shields when performing field inspections. Splash goggles should be used in addition to the safety glasses when there is potential exposure to acid mist and/or liquid chemicals.

Minimizing potential eye injuries. To the extent possible, inspectors should avoid areas directly underneath downward-pointed vents and horizontal vents.

Hearing Protection

Use hearing protection when necessary.

Hearing protection. Agency inspectors should use hearing protection when required by plant policies and when it is difficult to hear another person talking in a normal tone of voice from a distance of 2 ft. To the extent possible, the inspector should minimize the time spent in plant areas with high noise levels.

Electrical Hazards

Always use equipment with approved ground-fault interrupters.

Ground-fault interrupters. The agency inspector should not use line-powered equipment or instruments that are not served by an approved ground-fault interrupter.

Do not open electrical control cabinets.

Control cabinets. Under no circumstances should an inspector open an electrical cabinet to measure operating conditions, such as fan or pump currents, or to evaluate the operational status of ESP automatic voltage control circuits.

Know the location of and avoid high-voltage lines.

High-voltage lines. Before inspecting any facility, the inspector must ask responsible plant personnel to identify any high-voltage cables in the areas to be inspected (especially those that could be touched by long

sampling probes) and any lines that could be accidentally touched while the inspector is walking through the plant.

Bonding of probes. Agency inspectors should electrically bond all probes used downstream of ESPs, in fiberglass ducts, and in gas streams containing potentially explosive dusts.

Use electrically bonded probes.

Explosion Hazards

Grounding/bonding of sample bottles. Agency inspectors should electrically bond all sample bottles and funnels used to collect samples of fuel oils, waste oils, solvents, coatings, and other flammable liquids. Before taking the sample, the inspector should visually check the adequacy of the ground line for the main storage vessel. To bond the sample bottle and funnel properly, both must be constructed of a conducting metal. Failure to take the sample in this manner can result in an explosion caused by static electricity. If plant personnel fail to heed warnings concerning improper sample acquisition techniques, the inspector should leave the plant while the samples are being acquired.

Use electrically bonded sample bottles, funnels, etc., to collect samples of selected substances.

Portable equipment. Agency inspectors should never take battery-powered portable equipment, such as nonexplosion-proof flashlights, pH meters, and thermocouples, into areas of the plant where there are potentially explosive dusts and/or vapors. All equipment should be designed, tested, and approved by an underwriting laboratory before it is used in a hazardous environment.

Avoid the use of nonexplosion-proof battery-operated equipment.

Smoking. Smoking materials, including but not limited to matches and lighters, should never be taken into any facility.

Smoking materials should not be taken into any facility.

Burn Hazards

Hoppers. Agency inspectors should not stand in the immediate vicinity of hopper doors being opened and should not request plant personnel to open hopper hatches.

Solids handling lines. The solids handling lines should not be touched because they often carry solids at temperatures of several hundred degrees.

Probes. Sampling probes that are withdrawn from hot stacks and vents should be allowed to cool before being touched. The large port plugs should be handled only with gloves, because they can remain hot for several hours after being removed from the stack.

Steam leaks. In the event of high-pressure steam leaks, the inspector should immediately follow the recommended safety procedures at the plant.

Use caution around hot surfaces.

Hot ductwork. The inspector should avoid areas immediately around hot ducts.

Hot roofs. The inspector should avoid, to the extent possible, uninsulated hot roofs. Unfortunately, many common sources, such as coke ovens and asphalt concrete plants, typically have hot roofs, and it is sometimes necessary to visit these areas. In such cases, the inspector must wear proper footwear. When climbing up to potentially hot roofs, the inspector should wear gloves.

Ionizing Radiation Hazards

Nuclear instrumentation. The inspector should avoid areas around damaged level detectors and flow monitors because the lead shielding around the cesium 137 radiation source might be damaged.

Use caution around ionizing radiation sources (detectors).

Flow monitors. When working around ionizing radiation-type flow rate monitors (such as those often used on sewage sludge incinerators), the inspector should never reach between the radiation source and the detector.

Inhalation Hazards

Avoid partially confined areas, if possible.

Partially confined areas. To the extent possible, inspectors should avoid partially confined areas that allow the accumulation of airborne pollutants.

Use approved respirators and know their limits.

Selecting respirators. Inspectors should select appropriate respirators in accordance with EPA Administrative Order 1440.3, dated July 24, 1981 (and revisions). The order specifies that each person who is required to wear a respirator should complete training concerning the selection, use, fitting, and maintenance of the respirator. Furthermore, the respirator must not be worn when any condition would prevent a good seal. (The most common reason for an improperly fitted respirator is facial hair.)

Respirator limits. Inspectors must understand the protection limits of each respirator. A respirator must be used only for the specific contaminants listed in the EPA order and only for the concentration range listed. Because monitoring data are rarely available, the inspector must exercise some judgment when selecting the appropriate respirator.

Never enter areas believed to be O_2 deficient.

O_2-deficient atmospheres. Inspectors should not enter areas believed to be O_2 deficient.

Maintain respirators.

Respirator maintenance. Respirators must be inspected before and after each use (disposable respirators do not need to be checked after use). Equipment used only for emergencies must be inspected at least monthly. A record should be kept of the dates and results of all inspections. All respirators must be cleaned and disinfected after each use. All filters and cartridges must be replaced when necessary. Replacement of parts and

any repair should be done only by personnel with adequate training. Only certified parts supplied by the manufacturer should be used. The respirators should be stored in atmospheres that will protect them from dust, sunlight, extreme heat or cold, and damaging chemicals.

If you wear eyeglasses, have prescription lenses mounted in a full-face-mask respirator.

Eyeglasses in respirators. Individualized eyeglasses should be mounted to the face piece of full-face-mask respirators. Spectacle temple bars or straps that pass between the sealing surface and the wearer's face prevent efficient sealing; therefore, eyeglasses should not be used with a full-face-mask respirator.

Know your physical limits with respect to respirator use.

Physical limits to the use of respirators. Employees with perforated eardrums should not wear respirators. Employees who have not demonstrated, by means of regular physical examination, that they are capable of withstanding the additional physical stress imposed by respirators, should not wear them.

Gum and tobacco chewing with respirators. An inspector should not chew gum or tobacco while wearing a respirator.

Heat Stress Hazards

Carry drinking water.

Drinking water. Each inspector working in moderate and hot climates should carry drinking water. Heat stress can occur during inspections, even when ambient temperatures are low. The close proximity of high-temperature ducts and the limited air movement around some portions of the control system result in areas of high heat. The work involved in climbing the various platforms around the control equipment and the work involved in making some of the measurements also contribute to heat stress.

Interrupt the inspection if you experience heat cramps or heat exhaustion.

Heat exhaustion. The inspection should be interrupted immediately if an inspector experiences the symptoms of heat exhaustion, including but not limited to, fatigue, nausea, vomiting, headache, dizziness, clammy skin, and rapid pulse. The individual should rest in a cool place (but not less than 75 °F) and seek medical care as soon as possible. Heat stroke—a very serious condition requiring immediate medical help—can result if the inspector continues field activities during the onset of heat exhaustion.

Heat cramps. The inspection should be interrupted immediately if an inspector experiences heat cramps. The inspector should find a cool place to rest and should drink water containing 0.1 percent by weight salt (1 teaspoon per 5 quarts of water).

Wear clothing appropriate for the weather conditions.

Appropriate clothing. When working near nonradiant sources of heat, the inspector should wear light clothing to facilitate evaporative cooling. In general, when the temperature is less than 100 °F, the clothing should be light and loose fitting. When the temperature is greater than 100 °F,

clothing should cover as much of the body as possible to decrease the convective heat transfer from the surrounding air.

Avoid using clothing made mainly of synthetic materials.

Synthetic materials. In areas where there is high radiant heat, the inspector should avoid wearing clothing made of synthetic materials. Work clothes should be made primarily of cotton.

Cold Stress Hazards

Extreme weather conditions. When the ambient temperature is low, field inspectors should avoid wet areas and portions of the plant that are exposed to high-wind conditions.

Be prepared for cold weather conditions; have adequate clothing and supplies.

Appropriate clothing. During cold weather, the inspector must select clothing that provides the appropriate protection and reduces excessive perspiration. Clothing should be layered to trap heat and to provide the flexibility to adjust to both outdoor and indoor conditions while the inspector is conducting the inspection. Steel-tipped shoes should not be worn when the ambient temperature is low.

Cold weather supplies. Field personnel working in areas prone to severe winter conditions (e.g., Minnesota, North Dakota, South Dakota, Montana, Wyoming, Utah, and Alaska) should have a winter survival kit in their vehicles. This kit should include (but not be limited to) flares, a shovel, a sleeping bag, a compass, drinking water, a candle, food, and a two-way radio. Each individual should be trained in the proper procedures necessary to survive whiteout conditions and extended periods of extreme temperatures.

Absorbent-Chemical Hazards

Know hazards associated with absorbent chemicals and take precautions.

Personal protection equipment. Agency personnel should consult published reference materials concerning the selection and use of clothing (including gloves) when working with or near chemicals that are easily absorbed through the skin. A partial list of such chemicals is provided in the *OSHA Pocket Guide to Occupational Hazards.*

Sampling. Agency personnel should exercise extreme caution when sampling liquids containing chemicals that can be absorbed through the skin. Under no circumstances should the inspector allow direct contact between such liquids and the skin (e.g., hands and arms) while obtaining a sample.

Transportation Hazards (Materials And Supplies)

Transport compressed gas cylinders in accordance with DOT specifications.

Compressed gas cylinders. All compressed gas cylinders transported in cars and trucks must be secured according to Department of Transportation (DOT) specifications.

Potentially hazardous samples and supplies. All such materials must be packed and transported in accordance with DOT specifications to ensure that the material does not leak during routine transport or following an accident.

Transport hazardous materials in accordance with DOT specifications.

Biologically Active Material Hazards

Sampling. Agency inspectors should use extreme caution when sampling any solid or liquid material potentially containing bacteria and/or viruses. Such materials can be present in the scrubbing liquors for sewage sludge incinerators and in the solids fed to medical waste incinerators.

Airborne exposure. Bacteria and viruses can be entrained in the gas streams from improperly operating crematoriums and pathological waste incinerators. Exposure to effluents from such sources must be avoided. Inspectors should seek guidance from the EPA Safety and Health Office concerning the proper personal protection equipment and other procedures to be followed during field work near such sources.

Exercise extreme caution around biologically active materials and various forms of fungi found in the grain and feed industries.

Fungi. Exposure to some forms of fungi common in the grain and feed industries can lead to serious health problems. The proper respirator is necessary to minimize this exposure.

Unusual and Extreme Hazards

Inspectors must realize that safety procedures might have to be modified for unusual and extreme hazards at a specific site. It is the responsibility of the inspector, with the assistance of plant personnel, to identify these conditions. If there is any question concerning the proper health and safety procedures, the inspection (or other field activities) should be interrupted until guidance can be obtained from supervisory personnel.

Summary

Although field inspections always involve some risk, that risk can be minimized if the inspector follows basic safety guidelines and uses sound judgment.

An inspection should be immediately halted if the inspector suffers symptoms of exposure, or if the inspector finds that safety procedures and EPA policy are not being adhered to.

Review Exercises

1. Elevated areas are particularly dangerous for inspectors because:

   a. Climbing on improperly secured ladders might be required.
   b. Roofs might not be capable of supporting the weight of one or more individuals.
   c. The area might be littered with debris that is difficult for plant personnel to remove.
   d. All of the above.
   e. a and b only.

2. True or false? Inspectors should rely on plant personnel to point out all safety hazards that might be encountered during an inspection.

3. The following symptoms might indicate exposure to air contaminants:

   a. Headache
   b. Drowsiness
   c. Nausea
   d. Chest pains
   e. Shortness of breath
   f. Light-headedness
   g. Eye irritation
   h. All of the above
   i. a through d only
   j. e through g only

4. If an inspector experiences nonspecific symptoms of exposure to gases and vapors, he or she should:

   a. Discuss the potential exposure with plant personnel.
   b. Continue the inspection until more definite symptoms develop.
   c. Leave the area immediately and reevaluate the conditions.
   d. None of the above.

5. True or false? Out-of-service air pollution control devices or process equipment should be entered for inte- .l inspections.

6. Hard hats, safety shoes, and safety glasses should be worn during field work:

   a. Only when required by plant policies.
   b. Only when required by agency policies.
   c. For all ; ant inspections.
   d. When s, ecifically required for plant entry.

7. When climbing ladders, inspectors should keep their hands on the:

   a. Side rails
   b. Foot rails
   c. Side or fo-t rails

8. Hearing protection is necessary when normal conversation cannot be heard at a distance of ___ .

   a. 1 ft
   b. 2 ft
   c. 5 ft
   d. 10 ft

9. Static electricity is very likely following:

   a. A wet scrubber
   b. Electrostatic precipitation
   c. Mechanical collection
   d. All of the above

10. Ionizing radiation might be a problem with:

    a. ESP rappers
    b. CEMs
    c. ESP electrical cabinets
    d. Damaged level detectors and flow monitors
    e. All of the above

11. Partially confined areas where high concentrations of toxic materials might accumulate include:

    a. Weather enclosures
    b. Fan housings
    c. Pump houses
    d. Walkways between compartments of the collector
    e. Protected areas near large ducts
    f. Areas on top of floating-roof storage tanks
    g. All of the above
    h. a, d, and e only

12. Respirators should be inspected and cleaned by trained personnel:

    a. Before each use
    b. Before and after each use
    c. At least once a month

13. Before using a respirator, an inspector should:

    a. Be trained in selecting and using respirators
    b. Be trained in maintaining respirators
    c. Have a physical exam
    d. All of the above

14. True or false? Field activities should be halted immediately when the inspector experiences any symptoms of heat exhaustion, but the inspection should continue if heat cramps are the only symptom.

15. Appropriate cold weather gear includes:

a. Layers of clothing
b. Single outer jacket
c. Steel-tipped shoes
d. All of the above
e. a and c only

Answers

1. d. All of the above

2. False. Plant personnel might take certain conditions for granted and forget to point them out.

3. h. All of the above

4. c. Leave the area immediately and reevaluate the conditions.

5. False. Inspectors should never enter air pollution control devices or associated process equipment. All necessary information can be obtained without entering the device.

6. c. For all plant inspections.

7. b. Foot rails

8. b. 2 ft

9. b. Electrostatic precipitation

10. d. Damaged level detectors and flow monitors

11. g. All of the above

12. b. Before and after each use

13. d. All of the above

14. False. Any inspection should be interrupted immediately if an inspector experiences any exposure symptom, including heat cramps.

15. a. Layers of clothing

Quiz 3: Covering Lessons 10-13

This is the third self-graded quiz. It covers Lesson 10 through Lesson 13, with 5 to 9 items from each lesson. In addition to providing feedback on your mastery of the material, it gives you practice at taking a test in the final exam format. There is no answer sheet; just circle your responses on this quiz. After you have completed the quiz, use the answer key for Quiz 3 in the back of the book to check your responses.

1. ESPs are pollution control devices that:

   a. Use gravity settling, inertia, and dry impaction processes to collect pollutants.
   b. Handle large exhaust-gas volumes at high temperatures and low pressure drops.
   c. Operate more efficiently at low voltages.
   d. All of the above.
   e. b and c only.

2. The basic process underlying ESP operation is that:

   a. The pollutant particles are charged, the resulting electrostatic attraction causes them to adhere to the ESP walls, and then gravity pulls the particles into a hopper where they collect.
   b. Charged carbon particles attract pollutant particles, then the pollutant particles are separated by rapping or water sprays.
   c. The pollutant particles are separated by a combination of jets of air and electrical currents.
   d. The pollutant particles are charged, the resulting electrostatic attraction causes them to adhere to grounded surfaces, and they are removed from those surfaces by rapping or water sprays.

3. True or false? An ESP should operate at the maximum possible primary and secondary voltages.

4. True or false? In ESPs, if the resistivity for a given chamber is low, the power input to the chamber is a useful indirect index of the particle-removal efficiency.

5. Which conditions cannot be directly measured when using ESPs?

   a. Gas velocity through the ESP.
   b. Resistivity of the dust layer on the collection plate.
   c. Optimum rapping intensity.
   d. All of the above.
   e. a and b only.

6. Rappers, a component of ESPs, are mechanisms that are used for:

   a. Controlling the strength of the electric field between the discharge and collection electrodes.
   b. Removing dust from discharge and collection electrodes.
   c. Collecting and storing pollutant particles.
   d. Collecting the charged particles.

7. In an ESP, what is used to control the strength of the electric field generated between the discharge and collection electrodes?

   a. Rappers
   b. Electric partitioning
   c. T-R sets
   d. Discharge electrodes

8. True or false? Performance of an ESP can be evaluated by comparing the secondary currents, secondary voltages, and spark rates against baseline values for these parameters.

9. A field surveillance tool intended to provide frequent and specific observations of source performance is a:

   a. Level 1 inspection
   b. Level 2 inspection
   c. Level 3 inspection
   d. Level 4 inspection

10. True or false? During a Level 1 inspection, you should use EPA Reference Method 9 procedures to determine the average opacity of plumes.

11. During a Level 1 inspection, you should observe the stack and vents to see if a condensing plume is being emitted. Condensing plumes are:

    a. Light grey
    b. Dark grey
    c. Opaque white
    d. Bluish white

12. Level 1 inspections generally are not applicable tc

    a. Fabric filters
    b. Incinerators
    c. Mechanical collectors
    d. Carbon bed sorbers
    e. All of the above
    f. b and d only
    g. a and c only

13. The presence of droplet reentrainment is indicated by:

    a. Moisture and stains on adjacent equipment.
    b. A mud lip around the stack discharge.
    c. Obvious droplet fall in the immediate vicinity of the stack.
    d. All of the above.
    e. a and c only.

14. True or false? An agency inspector is usually quite familiar with the plant he or she is inspecting and is aware of most safety hazards in the plant.

15. What should inspectors do when they experience nonspecific symptoms of exposure to gases and vapors?

    a. Leave the area immediately and reevaluate the conditions.
    b. Take careful notes of the location and conditions experienced.
    c. Obtain a respirator and continue with the inspection.
    d. Continue with the inspection until more specific symptoms occur.

16. True or false? If a malfunction causes the complete shutdown of a control device, an inspector may enter that device and/or associated process equipment if accompanied by plant personnel.

17. When are inspectors required to wear hard hats, safety shoes, and safety glasses?

    a. When required by local agency policies.
    b. When required by plant policies.
    c. These are not required, but are optional.
    d. During all plant inspections.

18. True or false? During an inspection, inspectors should keep their hands on the side rails while climbing a ladder.

19. Because of ionizing radiation hazards, inspectors should use caution around damaged:

    a. Level detectors and flow monitors
    b. Ground-fault interrupters
    c. Control cabinets
    d. All of the above
    e. a and b only

20. To ensure proper maintenance, non-disposable respirators should be inspected by trained personnel:

    a. At least once a week
    b. At least once a month
    c. Before each use
    d. Before and after each use

21. True or false? The inspection should be interrupted immediately if an inspector experiences any symptoms of heat cramps or heat exhaustion.

22. A basic Level 2 inspection is:

    a. Used to gather baseline data to evaluate subsequent performance of specific sources.
    b. Intended to collect specific baseline data to evaluate performance of air pollution control devices and sources.
    c. Used when a more detailed and complete inspection is needed.
    d. A field surveillance tool that is intended to provide relatively frequent and specific visual observation of source performance.

23. True or false? Because portable instruments are not used during Level 2 inspections, it is important to evaluate the accuracy of the data collected from on-site instruments.

24. True or false? Plant entry is required during a follow-up Level 2 inspection, but is not required during a basic Level 2 inspection.

25. In wet scrubbers, corrosion of scrubber vessels can become severe when pH levels are:

    a. Between 5.5 and 10
    b. Greater than 7
    c. Less than 5.5
    d. Less than 7

26. A decrease in static pressure drop for a carbon bed adsorber could indicate:

    a. Partial pluggage of the carbon bed because of material entering the gas stream.
    b. Decreasing gas temperatures.
    c. That the carbon bed has deteriorated to the point that gas stream channeling is reducing the gas-solid contact.
    d. All of the above.
    e. b and c only.

27. True or false? It is important that fabric filters operate with static pressure drops of 5 to 7 inches.

28. True or false? For mechanically aided scrubbers, increased rotational speed indicates higher gas flow rates and higher static pressure drop across the scrubber.

Quiz 1: Answer Key

1. c. Identify abnormal operating conditions that might indicate common system malfunctions. (p. 1)

2. a. Evaluating control device performance by comparing present conditions with existing site-specific baseline data. (p. 1)

3. a. As much readily obtainable information as possible is used to evaluate performance. (p. 2)

4. True (p. 2)

5. False. It is the cocurrent flow approach (inspection from the beginning of the process to the stack) that is used on sources that do not have air pollution control devices to minimize emissions. (p. 4)

6. b. Raw material and fuel characteristics, operating rates, operating temperatures and pressures, and other process information relevant to generating air pollutants. (p. 5)

7. c. A field surveillance tool that is intended to provide relatively frequent and specific visual observation of source performance. (p. 5)

8. b. Level 2 (p. 6)

9. d. None of the above—the inspector is not permitted to enter the control device under any circumstances. (pp. 6 & 7)

10. True (p. 2)

11. c. Condensation, absorption, adsorption, combustion. (p. 11)

12. b. Electrostatic precipitation, gravity, diffusion, inertial impaction, centrifugal force. (p. 11)

13. d. Absorption (p. 12)

14. a. A process that involves removing gaseous contaminants by causing them to adhere to the surface of solid bodies with which they are in contact. (p. 12)

15. d. Time, temperature, and turbulence. (p. 12)

16. a. Concentration, characteristics, and chemical and physical properties. (p. 15)

17. b. Centrifugal force (p. 13)

18. True (p. 15)

19. True (p. 16)

20. False. Venturi scrubbers operate at high pressure drops. ESPs are designed to operate at much lower pressure drops. (p. 18)

21. True (p. 21)

22. c. Canopy, booth, slot, and flanged opening. (pp. 21 & 22)

23. False. Hoods are classified as either enclosure or nonenclosure. (p. 22)

24. a. Becomes progressively more negative with measurements taken closer to the fan. (p. 24)

25. c. Decrease as the gas moves farther from the process. (p. 24)

26. c. Centrifugal (p. 26)

27. d. At elbows or other points where there are sharp changes in gas flow direction. (p. 24)

28. c. Multiplying the fan motor rpm by the ratio of the motor and fan sheave diameters. (p. 27)

29. True (p. 29)

30. False. A shift of more than 20 percent in the corrected fan motor current from the baseline value indicates a significant change in the gas flow rate. (p. 30)

31. False. In a positive pressure baghouse, the fan is located before the baghouse and the dust-laden gas is pushed through the fabric filter. (p. 36)

32. d. All of the above. (p. 37)

33. d. Reverse air, pulse jet, and shaker. (p. 37)

34. True (p. 37)

35. d. All of the above. (p. 39)

36. False. In plenum pulse baghouses, an entire compartment is cleaned at one time. (p. 39)

37. a. O/I reverse air (p. 40)

38. b. I/O reverse air (p. 42)

39. b. Usually limited to static pressure drop gauges on each compartment and across the entire baghouse. (p. 43)

40. c. Reverse air (p. 39)

Note to student: For any item that you missed, you should review the corresponding text (page references are provided after each correct answer). Fewer than 12 incorrect responses corresponds to a passing grade on the final exam.

Quiz 2: Answer Key

1. False. Dry injection adsorption systems require more alkaline reagent than do the other two categories of dry scrubbers. (p. 59)

2. d. All of the above. (p. 59)

3. True (p. 59)

4. a. Rotary atomizers (p. 60)

5. True (p. 60)

6. d. All of the above. (p .62)

7. True (p. 61)

8. False. It is the dry injection adsorber that usually operates with a baghouse, and within the absorber vessel of the dry injection adsorber, the reagent is fluidized and mixed with the gas stream. (p. 61)

9. b. Liquid to remove particles or gases from exhaust streams. (p. 67)

10. a. Spray tower scrubber (p. 67)

11. c. Maximize the surface area available for absorption of gases and vapors. (p. 69)

12. True (p. 70)

13. c. Gas streams with high loadings of solids or with sticky particles. (p. 70)

14. a. Tray-type (p. 72)

15. d. Mechanically aided (p. 73)

16. False. Wear-resistant vanes are used in venturi scrubbers. (p. 74)

17. c. Mechanical collectors (p. 79)

18. b. Static pressure drop (p. 79)

19. c. Their inertia, which causes them to break out of the gas stream and hit the wall of the cyclone. (p. 80)

20. e. All of the above (p. 81)

21. a. Large-diameter cyclone (p. 81)

22. True (p. 83)

23. False. The physical condition of the cyclone body affects collection efficiency. (p. 81)

24. True (p. 81)

25. d. Multibed-type carbon bed adsorbers (p. 87)

26. True (p. 87)

27. a. Two variables in the carbon core—the heel and the working capacity. (p. 88)

28. b. The breakthrough point (p. 88)

29. a. Regeneration (p. 90)

30. False. Organic pollutants are typically desorbed by passing steam or hot gases through the bed in a direction opposite to the flow of gases during adsorption. (p. 90)

31. True (p. 90)

32. True (p. 88)

33. b. Incinerators (p. 95)

34. c. Form new, potentially more toxic compounds. (p. 95)

35. c. Masking (p. 95)

36. b Burner (p. 99)

37. False. The oxidation reaction proceeds at a faster rate and at a lower temperature in a catalytic incinerator than in a thermal incinerator. (p. 99)

38. False. Preheater burners are used in catalytic incinerators to achieve the required operating temperature. (p. 99)

39. d. Gradual recrystallization of the noble metal materials because of their exposure to hot combustion products. (p. 101)

40. True (p. 103)

Note to student: For any item that you missed, you should review the corresponding text (page references are provided after each correct answer). Fewer than 12 incorrect responses corresponds to a passing grade on the final exam.

Quiz 3: Answer Key

1. b. Handle large exhaust-gas volumes at high temperatures and low pressure drops. (p. 113)

2. d. The pollutant particles are charged, the resulting electrostatic attraction causes them to adhere to grounded surfaces, and they are removed from those surfaces by rapping or water sprays. (p. 114)

3. True (p. 117)

4. False. If resistivity is low, rapping conditions, gas flow conditions, and boiler load conditions are used to determine particle-removal efficiency. (p. 118)

5. d. All of the above (p. 117)

6. b. Removing dust from discharge and collection electrodes. (p. 113)

7. c. T-R sets (p. 116)

8. True (p. 117)

9. a. Level 1 inspection (p. 125)

10. True (p. 125)

11. d. Bluish white (p. 125)

12. f. b and d only (p. 126)

13. d. All of the above. (p. 126)

14. False. Inspectors are usually unfamiliar with the current conditions in a plant; therefore, they are more at risk from potential hazards than are plant personnel. (p. 152)

15. a. Leave the area immediately and reevaluate the conditions. (p. 152)

16. False. Inspectors should <u>never</u> enter air pollution control devices or associated process equipment. All necessary information can be obtained without entering the device. (p. 153)

17. d. During all plant inspections. (pp. 154 - 156)

18. False. Inspectors should keep their hands on the <u>foot rails</u> while climbing a ladder. (p. 155)

19. a. Level detectors and flow monitors (p. 158)

20. d. Before and after each use (p. 158)

21. True (p. 159)

22. b. Intended to collect specific baseline data to evaluate performance of air pollution control devices and sources. (p. 129)

23. True (p. 129)

24. False. Plant entry is required for all Level 2 inspections. (p. 129)

25. c. Less than 5.5 (p. 144)

26. c. That the carbon bed has deteriorated to the point that gas stream channeling is reducing the gas-solid contact. (p. 138)

27. False. Fabric filters operate with a wide range (2 to 12 in.) of static pressure drops. (p. 131)

28. True (p. 135)

Note to student: For any item that you missed, you should review the corresponding text (page references are provided after each correct answer). Fewer than 9 incorrect responses corresponds to a passing grade on the final exam.

If You Want To Know More

The following publications are recommended for supplemental reading. These materials are not included with the course materials and are not necessary for successful completion of Course 445. If the following works are not available from your state or local agency, contact the Air Pollution Training Institute for assistance in obtaining these materials.

American Conference of Governmental Industrial Hygienists. 1980. *Industrial Ventilation, 16th Edition.* Michigan.

Calvert, S., et al. 1972. *Wet Scrubber System Study, Volume I: Scrubber Handbook.* EPA-R2-72-118a.

Katz, J. 1979. *The Art of Electrostatic Precipitation.* Pittsburgh: S & S Printing Company.

Mappes, T.E. and Tems., R.D. 1981. *An Investigation of Corrosion in Particulate Control Equipment.* EPA-340/1-81-002.

McDonald, J.R. and Dean, A.H. 1980. *A Manual for the Use of Electrostatic Precipitators to Collect Fly Ash Particles.* EPA-600/8-80-025.

PEI Associates, Inc. 1984. *Operation and Maintenance Manual for Electrostatic Precipitators.* EPA-625/1-85-017.

_____. 1986. *Operation and Maintenance Manual for Fabric Filters.* EPA-625/1-86-020.

U.S. Environmental Protection Agency (EPA). 1982. *Control Techniques for Particulate Emissions from Stationary Sources, Volume I.* EPA-450/3-81-005a.

White, H. 1977. *Electrostatic Precipitation of Fly Ash.* Air Pollution Control Association.

Yung, S., Calvert, S. and Barbarika, H.F. 1977. *Venturi Scrubber Performance Model.* EPA-600/2-77-172.